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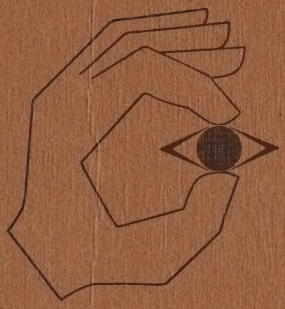

TELEQUIPMENT

OSCILLOSCOPE

TYPE S51B & S51E

MANUAL

TELEQUIPMENT

OSCILLOSCOPE

TYPE S51B AND S51E

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GENERAL DESCRIPTION

The S51 Oscilloscope is produced in two versions:

S51B - A general purpose oscilloscope with improved X input facilities, replacing both the S51A and S51T models.

S51E - A simplified educational version of the S51B with the NORMAL-TV FIELD switch and INT-EXT switch both deleted, and the time base always triggered by an internal signal. Also in the S51E the sawtooth voltage is brought out to a terminal on the front panel, which replaces the EXT TRIG terminal on the S51B.

CATHODE RAY TUBE

The 5 in diameter flat-faced tube operates at 3kV overall, giving an extremely bright fine trace over the whole of the working area (8 x 10 cm). The tube normally fitted has a P31 phosphor, P7 and P11 are available if specified.

A coloured filter improves the contrast under conditions of high ambient light.

VERTICAL DEFLECTION AMPLIFIER

The amplifier consists of three stages and has a maximum sensitivity of 100mV/cm and a bandwidth of d.c. to 3MHz (-3dB approx.), 2Hz-3MHz a.c.-coupled. The input impedance is 1MΩ, shunted by about 47pF.

The nine-position input attenuator is frequency compensated and gives sensitivities of 100, 200 and 500mV, 1, 2, 5, 10, 20 and 50V per cm with an accuracy of ± 5%.

SWEEP CIRCUIT

The sweep generator consists of a Miller run-down circuit. There are six preset sweep speeds in decade steps from 1μs/cm to 100ms/cm. A variable control with a 10:1 range provides overlap between fixed speeds and reduces the slowest sweep speed to 1s/cm. The timing accuracy is ± 5%.

The sweep voltage is fed to a rear socket, also to a front terminal on the S51E, and consists of a negative going sawtooth of approximately 20V p.-p. at a mean d.c. level of approximately 30V.

HORIZONTAL AMPLIFIER

The amplifier, when switched for external use with VARIABLE switched to OFF, has an approximate sensitivity of 100mV/cm, 3dB bandwidth of d.c. - 500kHz and input impedance of 1MΩ in parallel with 100pF. The X GAIN control has an approximate 2:1 range. An external signal is fed to the amplifier input via a rear socket.

When the internal sweep is used, sufficient shift is provided for any part of an expanded trace to be positioned centrally.

The amplifier is independently usable as a d.c. amplifier, with gain and bandwidth in excess of X10 and 500kHz, the amplifier output is fed to the rear SAWTOOTH OUT socket and also to the front SWEEP OUTPUT terminal on the S51E.

TRACE UNBLANKING

D.c. coupling of the unblanking waveform gives uniform trace brightness at all sweep speeds and operates in such a way that the time base flyback is completely eliminated.

TRIGGERING

Two modes of triggering are provided.

AUTO. On this setting the sweep free runs at a slow speed in the absence of an input signal but will be triggered automatically by signals between about 50Hz and 1MHz provided that the amplitude of display exceeds approximately 5mm. No control over the trigger level is available in AUTO, the sweep is triggered at approximately the mean level of the input waveform.

TRIGGER LEVEL SELECTION. With the AUTO switch off, the TRIG LEVEL control allows the sweep to be triggered at any point on the input waveform. The circuit will trigger internally on 2mm of displayed signal, and externally (except S51E) from 3V p.-p.

TV SYNC (S51B only)

The built-in TV sync integrator circuit makes it possible to trigger the sweep from the field pulses of a composite television waveform.

EXTERNAL INTENSITY MODULATION

A rear socket enables the beam intensity to be modulated. The socket is coupled via a blocking capacitor to the grid of the CRT, a negative going signal of approximately 15V is required for cut-off at average brightness. The input time constant is 10ms, formed by 0.01μF and 1MΩ.

COOLING

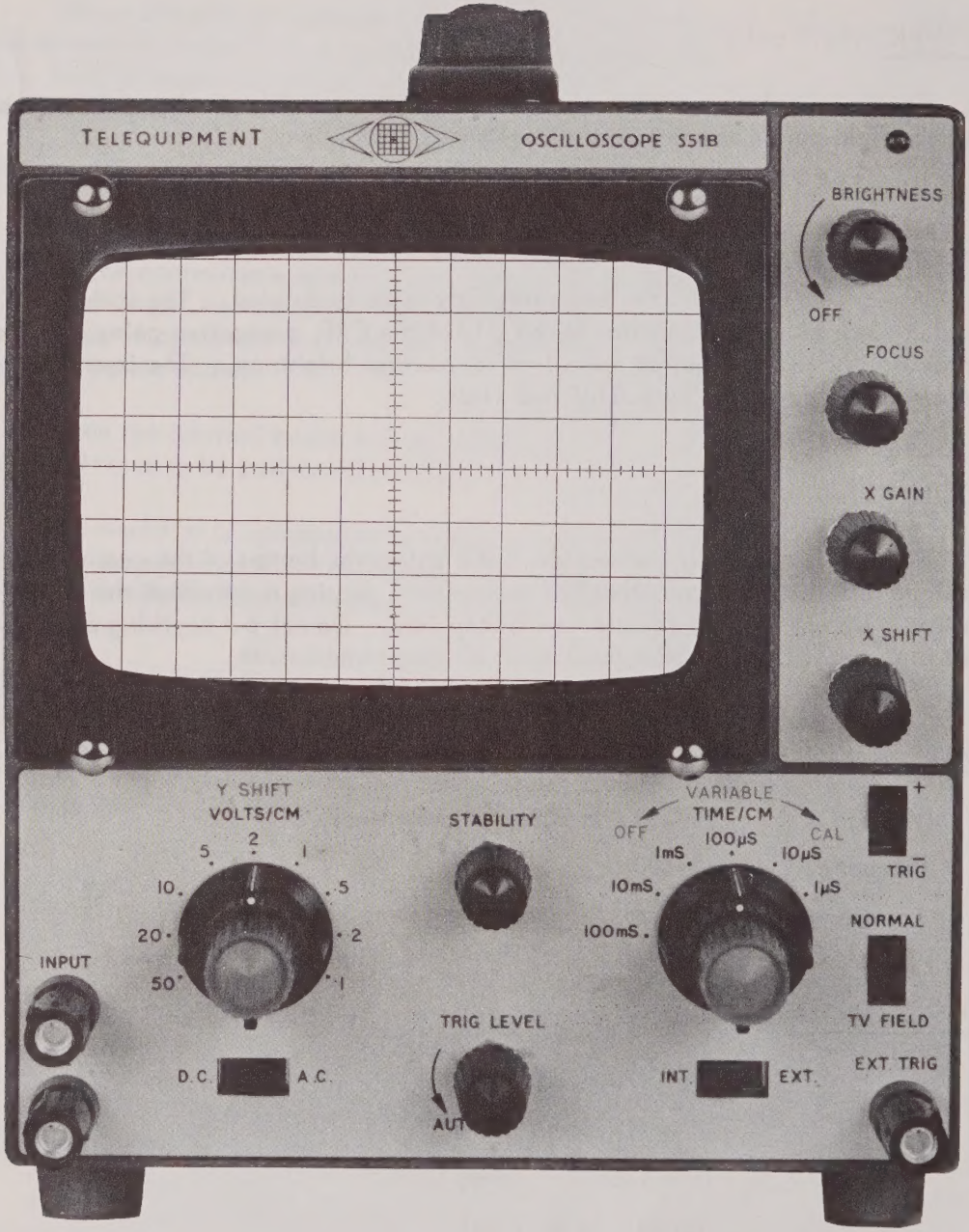
The S51 is cooled by convection. Air enters the bottom of the case and is drawn up past the tubes and other hot components, passing out through the slots at the top. Do not obstruct the air flow in any way. Do not put anything on top of the instrument and ensure that there is an air space underneath.

POWER REQUIREMENTS

Voltage	90-130 and 200-240 in 5V steps.
Frequency	50-400Hz.
Consumption	58VA.

DIMENSIONS

8 in (20.4cm) high
7 in (17.8cm) wide
15 in (38cm) deep
Weight: 16 lb (7 kg)

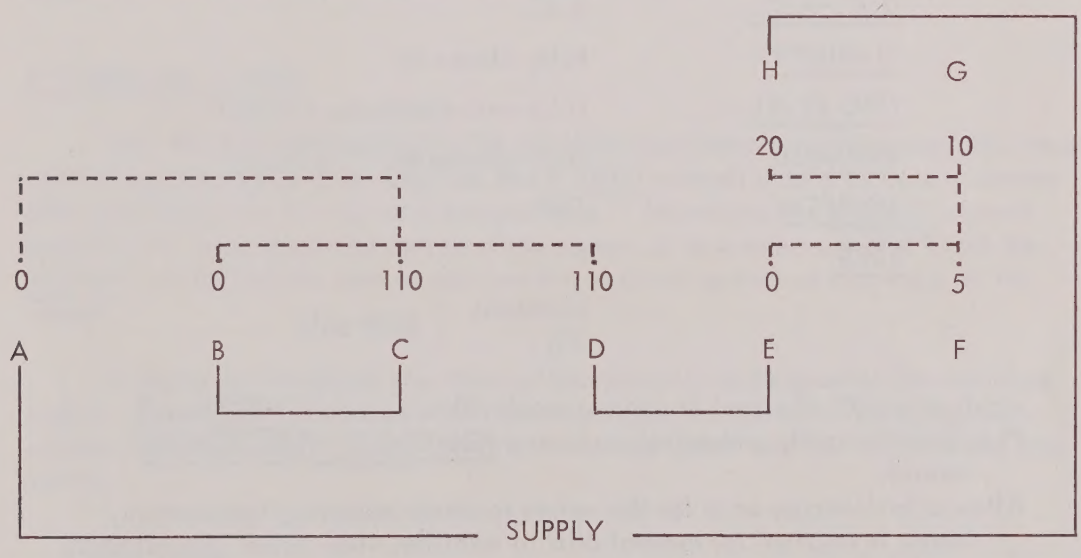

TELEQUIPMENT
OSCILLOSCOPE 551B
BRIGHTNESS
OFF
FOCUS
X GAIN
X SHIFT
Y SHIFT
VOLTS/CM
5
2
1
10
20
50
.5
.2
.1
INPUT
D.C.
A.C.
STABILITY
TRIG LEVEL
AUT
VARIABLE
TIME/CM
OFF
CAL
100µS
1mS
10µS
10mS
1µS
100mS
INT.
EXT.
+
TRIG
−
NORMAL
TV FIELD
EXT. TRIG

FIRST TIME OPERATION

CHECK SUPPLY VOLTAGE AND FUSE

Before connection to the mains supply check that the transformer primary windings are interconnected to suit the local supply voltage and that the fuse is of the correct rating, 1A for 90 to 130V and 500mA for 200 to 240V. For access to the transformer, remove the case after unscrewing the two screws at the rear of the instrument.

RELEVANT TRANSFORMER CONNECTIONS



90-130V Link A to B and C to D. Connect link and supply leads as below.

200-240V Link B to C. Connect link and supply leads as below.

Supply voltage	90 200	95 205	100 210	105 215	110 220	115 225	120 230	125 235	130 240
Link	DH	DH	DG	DF	-	DE	DE	DF	DE
Supply to	AE	AF	AE	AE	AD	AF	AG	AH	AH

The interconnections for 240V operation are illustrated.

USE OF CONTROLS

Set the controls as follows:

BRIGHTNESS	Fully anti-clockwise - OFF
FOCUS	Mid position
X GAIN	Fully anti-clockwise
X SHIFT	Mid position
Y SHIFT	Mid position
VOLTS/CM	.5
D.C.-A.C.	A.C.
STABILITY	Fully clockwise
TRIG LEVEL	Fully anti-clockwise - AUTO
VARIABLE	Fully clockwise
TIME/CM	1mS
TRIG	+
	NORMAL) S51B only INT)

Apply about 2V of signal at approximately 50Hz between INPUT and E.
Plug into the supply and switch on by the POWER OFF - BRIGHTNESS control.
Allow a half-minute or so for the valves to attain operating temperature, longer is required for thermal drift to stabilise, then adjust BRIGHTNESS and FOCUS for a sharp trace of convenient intensity.
Centre the trace by X and Y SHIFT.
Rotate STABILITY anti-clockwise until a stable trace is obtained.
The input waveform should now be observed.

When switched from AUTO, the TRIG LEVEL control enables the starting point of the sweep to be selected from any point on the positive going slope of the displayed waveform. If the TRIG polarity switch is now set to -, the same will be seen to apply to the negative going slope.

For signals of other frequency and amplitude, the TIME/CM, VARIABLE and VOLTS/CM controls should be adjusted as appropriate.

TRIGGERING (S51B only)

Provision is made for triggering the sweep externally and from TV field (frame) pulses.

TV FIELD Trigger polarity relates to the polarity of video modulation. The effect of the integrating circuit enables the TRIG LEVEL control to be used to select which of the broad field sync pulses triggers the sweep. The TV FIELD position should be selected when triggering from a low frequency signal modulated by high frequencies, the integrator acting as a low pass filter.

EXT In this setting, a signal of over 3V p.-p. applied between the EXT TRIG terminal and E may be used to trigger the sweep.

X GAIN and X SHIFT

With the X GAIN control in the minimum (anti-clockwise) position, the trace will be approximately 8 cm long and the X SHIFT control should be used to centre this trace about the 8 x 10 cm ruled graticule. Increasing the X GAIN control expands the trace about the centre of the screen up to a maximum of x 2 and the X SHIFT control is then used to position the required portion of this trace on the screen.

It should be noted that the time calibration only holds good at the minimum setting of the X GAIN control. If time intervals are required to be measured at another setting of the X GAIN control, the sweep speed must be calibrated at this setting.

VOLTS/CM

This is a nine-position switch which inserts a series of frequency compensated resistive dividers between the input socket and the vertical amplifier. Normally, this is used merely to obtain a display of convenient height, but if the gain of the amplifier is standardised, direct readings of the input voltage can be made.

D.C.-A.C. SWITCH

On the A.C. position this switch inserts a blocking capacitor in series with the input of the vertical amplifier, removing the d.c. component of the signal. This is the condition in which the S51 will normally be used unless it is specifically required to include the d.c. component or to use the instrument on very low frequency signals. The time constant of the input circuit on the A.C. position is such that the response is 3 dB down at 2Hz, which, while adequate for most purposes, may limit the application in some instances. For example, it will be noticed that on a 50Hz squarewave a pronounced tilt occurs on the A.C. position. If a longer time constant is required, a higher capacity external blocking capacitor must be used, with the input switch set to D.C.

SWEEP OUTPUT (S51E only)

This terminal is connected to the rear SAWTOOTH OUT socket, reference should be made to the following section.

REAR SOCKETS

X IN provides an access to the input of the directly coupled horizontal deflection amplifier and is suitable for signals between about 0.1 and 2V p.-p. The X GAIN control gives about a 2:1 variation of gain. When using the X amplifier the sweep can be stopped by turning the VARIABLE control fully anti-clockwise.

Z IN is connected via a blocking capacitor to the grid of the CRT. Thus, a positive pulse will brighten the trace.

SAWTOOTH OUT carries a d.c. potential of around 30V, dependent on the X SHIFT setting. Care should be taken to avoid shorting this socket to ground, a minimum load resistance of about 100 kilohms is desirable. With the timebase running, a negative-going sawtooth of approximately 20V p.-p. is available.

With the timebase switched off, an amplified and phase-inverted version of a signal applied to X IN is obtained.

CIRCUIT DESCRIPTION

VERTICAL AMPLIFIER

The vertical amplifier consists of three double triodes. V1a and b form a cathode coupled amplifier stage with RV6 acting as the gain control.

The signal is taken from V1b anode and drives the output stage V3 via cathode follower V2a.

V3 consists of a long-tailed pair with the signal taken to V3a and the vertical shift applied to V3b.

V2b acts as a low impedance HT supply for V1, also providing approximately 150V for Y shift and timebase circuits.

The signal at the anode of V3b is taken to the INT-EXT trigger switch.

The HT supply for the trigger circuit, V4 and V5b is taken from a common resistor R15 in the cathode circuit of V3.

TRIGGER CIRCUIT

The trigger selection is performed by three switches in the S51B and one in the S51E; S2 selects the INT-EXT triggering signal and connects it to the grid of phase splitter V4b. S3 selects the positive or negative output of the phase splitter and connects it to S4 which either passes the signal directly or via an integrating circuit to V4a. The latter position, TV FIELD, integrates the field pulses of a television waveform and attenuates the line pulses allowing the time base to be triggered by the field sync pulses.

From S4 the signal is fed to V4a and V5b which form a cathode coupled bistable switch, the switching level being adjusted by the grid potential of V4a. On the AUTO position the switch S5 is opened and the grid of V4a is returned to the grid of V5b. In the absence of a signal V4a and V5b oscillate at a frequency determined by the time constant R42 and C19, but as soon as any input signal between about 50Hz and 1MHz is applied to the grid of V4a, the self-oscillation ceases and the multivibrator synchronises to the signal frequency. The square wave appearing at the anode of V5b is differentiated, the positive pulse removed by MR7 and the negative pulse used to trigger the time base.

TIMEBASE & HORIZONTAL AMPLIFIER

V6a is the Miller sweep generator, the speed of run down being controlled by S8 and the VARIABLE speed control.

The Miller valve is keyed by V5a and V6b which together form a d.c. coupled multivibrator.

In the rest position of the timebase, V5a is off and its anode potential is clamped by MR8 and 9. V6b is conducting. A negative trigger pulse from V5b lowers the grid potential of V6b and hence that of the anode of V6a. This is coupled to the grid of V6a, so reducing the valve current. The resulting rise in screen potential developed across R65 is coupled via R54 and S6a to the grid of V5a. This causes V5a anode voltage to fall, which leads to regenerative action whereby V6b becomes quickly cut off and V5a hard on.

When the run down has reached the point where the cathode voltage of V6b has fallen to near that of the grid, V6b starts to conduct and a negative pulse is applied to the grid of V5a. Regeneration again takes place driving V5a to cut off and V6b to conduction.

The positive going voltage at V6b anode, developed during the sweep, is coupled via S6b to the modulator plate of the CRT, to provide trace unblanking.

The STABILITY control RV49 serves to set the grid potential of V5a to the point just short of the free running condition of V5a and V6b.

The linear sweep voltage at the anode of V6a is taken via R64, C41 and R73 to one grid of the horizontal amplifier V7, horizontal shift voltage is applied to the other grid and the output at the anodes drives the CRT X plates in push-pull.

Transistor TR1 in the common cathode circuit, acts as a constant current source and provides a balanced output at the two anodes.

An external signal may be applied through a connector at the rear of the instrument. In this condition, the timebase should be switched off with the VARIABLE speed control. V5a is then switched for use as a preamplifier, the signal being applied to its grid. Cathode bias is provided by RV56, decoupled by C25. The signal at V5a anode is coupled via V6b, acting as a cathode follower, and S6d to the horizontal output amplifier V7. In order to keep the d.c. conditions correct, V5a and V6b anodes are switched by S6b to the 150V HT supply and in addition V6b anode is decoupled by C26.

POWER SUPPLY

Silicon rectifiers MR1 and 2 in a voltage doubling circuit supply the various HT voltages via smoothing resistor R24.

The negative EHT supply for the CRT and STABILITY control via R29 is provided by MR3, 4 and 5, C8, 9 and 11. It is applied via voltage reference neons N1 and 2, in parallel with the BRIGHTNESS control, to the cathode of the CRT.

The positive EHT supply is derived from MR6 and C12. The negative end of C12 is returned to the HT line.

CRT

Intensity modulation signals may be applied via C16 to the grid of the CRT.

The interplate shield potential is adjusted by RV88 to the mean potential of the deflector plates for optimum geometry or freedom from bowing of the display. RV89 provides preset astigmatism adjustment and RV92, blanking, allows the beam intensity to be adjusted to a maximum by varying the first anode potential.

MAINTENANCE ADJUSTMENTS

The simplicity of the circuitry of the S51 makes it an extremely reliable instrument, and for the most part servicing will be limited to the replacement of defective valves. Valve replacement will have little effect on performance and should not necessarily entail readjustment of preset controls. If for any reason the internal presets do require adjustment, the following detailed instructions will allow this to be done quickly and accurately.

The case may be removed after unscrewing the two screws at the rear of the instrument.

INPUT ATTENUATOR & PROBE

In order to adjust the input attenuator compensation a squarewave generator is required with a frequency of approximately 2kHz and whose output can be varied between 0.2 and 100V. The rise time of the squarewave need not be particularly fast, but it must have a flat top and bottom. Connect the squarewave generator to the input socket and adjust the output to approximately 0.2V. Set the input attenuator to .1 and adjust the sweep controls so that 3 cycles of the squarewave are displayed. Now carry out the following procedure step by step, adjusting each trimmer to give a square corner to the squarewave. On each setting of the input attenuator the output of the squarewave generator should be adjusted to give a display of approximately 2-3 cm amplitude.

Set VOLTS/CM to:	Adjust
.2	C112
.5	C111
1	C104
2	C108
5	C109
10	C105

If these adjustments have been carried out correctly the 20 and 50V/cm ranges are automatically compensated.

In order to adjust C102 and 103 it is necessary to use a high impedance probe, as these two capacitors only affect compensation when a probe is in use. Remove

the squarewave generator from the input socket and plug in the high impedance probe, connect the output of the squarewave generator to the probe tip and set the input attenuator to .1, set the output of the squarewave generator to give approximately 2cm amplitude and adjust the probe trimmer to give a flat top to the squarewave. Now switch the input attenuator to 1, readjust the output of the squarewave generator and adjust C102. Set the input attenuator to 10, readjust the generator and adjust C103. All other ranges will automatically be correct.

VERTICAL AMPLIFIER

Adjustment of the high frequency compensation of the vertical amplifier should only be carried out if a squarewave generator is available which is capable of producing an accurate squarewave at a frequency of about 250kHz with a rise time of less than 100ns and which is known to be absolutely free from ring or overshoot. The compensation circuits in the vertical amplifier are extremely stable and unless such a generator is employed readjustment is undesirable.

Set the input attenuator switch to 0.1 and adjust the output of the squarewave generator to give a trace of approximately 2-3cm amplitude (the output frequency of the generator should be between 200 and 300kHz). L1 is adjusted to give a flat topped squarewave with a fast rise time, square corners and no overshoot.

The only other variable on the vertical amplifier is the SET Y GAIN control, which should be adjusted with a signal of known amplitude with appropriate setting of the VOLTS/CM switch.

TRIGGER CIRCUIT

The only adjustment necessary in the trigger circuit is an occasional resetting of the trigger sensitivity control RV48; this should be set so that the trigger circuit will operate when the trace amplitude on the screen exceeds 2mm. If any attempt is made to increase the sensitivity beyond this point erratic operation will almost inevitably result. Connect a signal, say a 2kHz squarewave, to INPUT. Now set the input attenuator and squarewave generator to give a trace 2mm high and adjust the TRIG SENS control so that, at a critical setting of the TRIG LEVEL control, the sweep will just trigger. Reduce the trace amplitude to 1mm and make sure that the sweep will not trigger on this signal.

SWEEP GENERATOR & HORIZONTAL AMPLIFIER

To make a complete readjustment of the sweep generator and horizontal amplifier, carry out the following procedure:-

Remove the lead to the modulator anode, pin 7 on the CRT. Set the TIME/CM switch to 100μS. Now advance the BRIGHTNESS control until the spot at the beginning of the trace may be seen. By adjusting C41 a small tail may be made to appear on one side of the spot or the other. The correct setting for C41 is the point at which this tail just disappears into the spot.

Reconnect the lead to the modulator anode on the CRT.

Now set the TIME/CM switch to 100μS and the VARIABLE speed to the CAL position. X GAIN should be at minimum and the trace centred by the X SHIFT control.

Connect accurately known 100μS marker pulses or an accurate 10kHz square-wave to the input terminals and adjust RV72 for 1 pulse or cycle per cm. As adjustment of RV72 will cause the trace to move horizontally, it should be recentred using the X SHIFT control. For greatest accuracy, calibration should be carried out over the centre 4 cm of horizontal trace.

To set up the X amplifier, adjust X SHIFT until the start of the sweep is at the centre of the screen. Turn the VARIABLE speed control to the timebase off position and adjust trace position (RV56) so that the spot is in the centre of the screen. Feed into X IN a sine wave of 0.5V p.-p. Now adjust X GAIN until 5cm of trace is displayed. The X amplifier is now set to 100mV/cm.

CRT CIRCUIT

Feed 0.5V p.-p. into both X and Y inputs, with VOLTS/CM at .1, and a diagonal line will be produced. By varying the X and Y shifts, see that the trace remains undistorted over the tube face. If any bowing occurs, adjust interplate shield potential, (RV88), to straighten.

Remove the X input and set TIME/CM to a convenient speed, adjust RV89, ASTIG, in conjunction with FOCUS for optimum trace definition.

Remove the Y input and reduce BRIGHTNESS, adjust RV92, BLKG, for maximum trace intensity.

On tube replacement, the link across N2 is removed if the range of the BRIGHTNESS control is not adequate to cut off the beam.

COMPONENT LIST

All resistor and capacitor values are in ohms and microfarads and ratings, at 70°C, in watts and volts respectively unless otherwise stated.

Carbon resistors are of 10% tolerance and $\frac{1}{4}$ W rating unless otherwise shown.

Whenever possible exact replacements for components should be used. These may be ordered from the company or its agents stating:-

(1) Instrument type
(2) Instrument serial number
(3) Component circuit reference
(4) Component part number
(5) Component value

For standard components, locally available alternatives may be satisfactory.

ABBREVIATIONS

C	Carbon composition	MO	Metal oxide
CER	Ceramic	P	Paper
CP	Carbon preset	PE	Polyester
CT	Ceramic trimmer	PS	Polystyrene
CV	Carbon variable	Se	Selenium
E	Electrolytic	Si	Silicon
Ge	Germanium	SM	Silver mica
HS	High-stability carbon		

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313 Chase Road
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LONDON, N.14
ENGLAND.

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CABLES: TELEQUIPT LONDON N.14

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R1	316-0125-01	1.2M	C		
R2	316-0125-01	1.2M	C		
R3	316-0101-01	100	C		
R4	316-0101-01	100	C		
R5	316-0471-01	470	C		
RV6	311-0725-00	500	CP	30	0.1
R7	316-0562-01	5.6k	C		
R8	316-0471-01	470	C		
R9	316-0101-01	100	C		
R11	316-0152-01	1.5k	C		
R12	303-0273-01	27k	C	5	1
R13	303-0472-01	4.7k	C	5	1
R14	303-0222-01	2.2k	C	5	1
R15	303-0153-01	15k	C	5	1
R16	307-0160-00	1k	MO	5	3¼
R17	303-0472-01	4.7k	C	5	1
R18	316-0472-01	4.7k	C		
R19	316-0101-01	100	C		
R21	316-0682-01	6.8k	C		
RV22	311-0744-00	10k	CV	20	0.1
R23	316-0563-01	56k	C		
R24	307-0169-00	500	MO	5	3¼
R25	316-0185-01	1.8M	C		
RV26	311-0811-00	1M	CV	20	¼
RV27	311-0822-00	1M	CV (with S1)	20	¼
R28	316-0105-01	1M	C		
R29	316-0155-01	1.5M	C		
R31	316-0104-01	100k	C		
R32	316-0125-01	1.2M	C		
R33	316-0125-01	1.2M	C		
R34	316-0471-01	470	C		
R35	316-0472-01	4.7k	C		
* R36	316-0223-01	22k	C		
R37	316-0472-01	4.7k	C		
RV38	311-0769-00	100k	CV (with S5)	20	¼
R39	316-0563-01	56k	C		
R41	316-0101-01	100	C		
R42	316-0105-01	1M	C		
R43	316-0472-01	4.7k	C		
R44	316-0224-01	220k	C		
R45	303-0472-01	4.7k	C	5	1
R46	316-0104-01	100k	C		
R47	316-0272-01	2.7k	C		
RV48	311-0752-00	1M	CP	30	0.1
RV49	311-0811-00	1M	CV	20	¼
R51	316-0225-01	2.2M	C		
R52	316-0472-01	4.7k	C		

* Omitted from S51E

Carbon resistors are 10% ¼W unless otherwise shown

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R53	316-0105-01	1M	C		
R54	316-0824-01	820k	C		
R55	316-0471-01	470	C		
RV56	311-0803-00	4.7k	CP	20	0.1
R57	303-0104-01	100k	C	5	1
R58	316-0101-01	100	C		
R59	316-0101-01	100	C		
R61	316-0224-01	220k	C		
R62	303-0822-01	8.2k	C	5	1
R63	316-0564-01	560k	C		
R64	316-0155-01	1.5M	C		
R65	316-0473-01	47k	C		
R66	316-0471-01	470	C		
R67	319-0114-00	6.1M	HS	2	¼
R68	319-0115-00	680k	HS	1	¼
R69	316-0272-01	2.7k	C		
R70	319-0099-00	170k	HS	1	¼
RV71	311-0762-00	50k	CV (with S7)	20	¼
RV72	311-0752-00	1M	CP	30	0.1
R73	316-0101-01	100	C		
R74	303-0393-01	39k	C	5	1
R75	316-0332-01	3.3k	C		
R76	315-0334-01	330k	C	5	¼
R77	315-0622-02	6.8k	C	5	¼
RV78	311-0743-00	10k	CV	20	0.125
R79	303-0393-01	39k	C	5	1
R81	316-0332-01	3.3k	C		
R82	319-0042-01	1k	C	1	¼
R83	316-0471-01	470	C		
R84	316-0224-01	220k	C		
R85	316-0154-01	150k	C		
RV86	311-0775-00	100k	CV	20	¼
R87	316-0224-01	220k	C		
RV88	311-0752-00	1M	CP	30	0.1
RV89	311-0760-00	50k	CP	30	0.1
R91	316-0104-01	100k	C		
RV92	311-0737-00	10k	CP	30	0.1
R93	316-0224-01	220k	C		
R94	316-0104-01	100k	C		
R95	316-0563-01	56k	C		
R101	319-0005-01	900k	HS	1	¼
R102	319-0119-00	990k	HS	1	¼
R103	319-0096-00	111k	HS	1	¼
R104	319-0120-00	10.1k	HS	1	¼
R105	319-0112-00	500k	HS	1	¼
R106	319-0118-00	800k	HS	1	¼
R107	319-0031-01	1M	HS	1	¼
R108	319-0103-00	250k	HS	1	¼
R109	319-0031-01	1M	HS	1	¼
R110	316-0104-01	100k	C		

Cct. ref.	Part number	Value	Description	Tol. %	Rating
C1	285-0772-00	0.1	PE	10	400
C2	285-0772-00	0.1	PE	10	400
C3	290-0347-00	8	E		300
C4	290-0368-00	32	E		350
C5	290-0379-00	32	E		275
C6	290-0379-00	32	E		275
C7) C13)	290-0376-00	32+32	E		450
C8	290-0365-00	16	E		450
C9	290-0365-00	16	E		450
C11	290-0365-00	16	E		450
C12	285-0766-00	0.05	P	10	2k
C14	285-0772-00	0.1	PE	10	400
C15	285-0772-00	0.1	PE	10	400
C16	281-0677-00	0.01	CER		1.5k
* C17	285-0772-00	0.1	PE	10	400
* C18	285-0769-00	0.01	PE	20	400
C19	285-0788-00	0.1	PE	10	125
C21	285-0772-00	0.1	PE	10	400
C22	285-0843-00	30p	PS	2p	500
C23	285-0854-00	100p	PS	2p	350
C24	285-0788-00	0.1	PE	10	125
C25	285-0851-00	3,600p	PS	1	125
C26	290-0113-01	8	E		150
C27	285-0844-00	39p	PS	2p	500
C28	285-0854-00	100p	PS	2p	350
C29	285-0858-00	1,000p	PS	1	350
C31	285-0769-00	0.01	PE	20	400
C32	285-0772-01	0.1	PE	10	400
C33	285-0847-00	560p	PS	5	125
C34	285-0839-00	0.2	PE	2	160
C35	285-0778-00	0.02	PS	1	350
C36	285-0859-00	1,900p	PS	2½	350
C37	285-0854-00	100p	PS	2p	350
C38	285-0845-00	68p	PS	2p	500
C39	281-0137-00	6-30p	CT		350
C41	281-0130-00	4-20p	CT		
C42	285-0772-00	0.1	PE	10	400
C101	285-0772-00	0.1	PE	10	400
C102	281-0137-00	6-30p	CT		350
C103	281-0137-00	6-30p	CT		350
C104	281-0137-00	6-30p	CT		350
C105	281-0137-00	6-30p	CT		350
C106	285-0854-00	100p	PS	2p	350
C107	285-0850-00	1,000p	PS	5	125
C108	281-0137-00	6-30p	CT		350
C109	281-0137-00	6-30p	CT		350
C110	283-0653-00	5p	SM	10	350
C111	281-0137-00	6-30p	CT		350

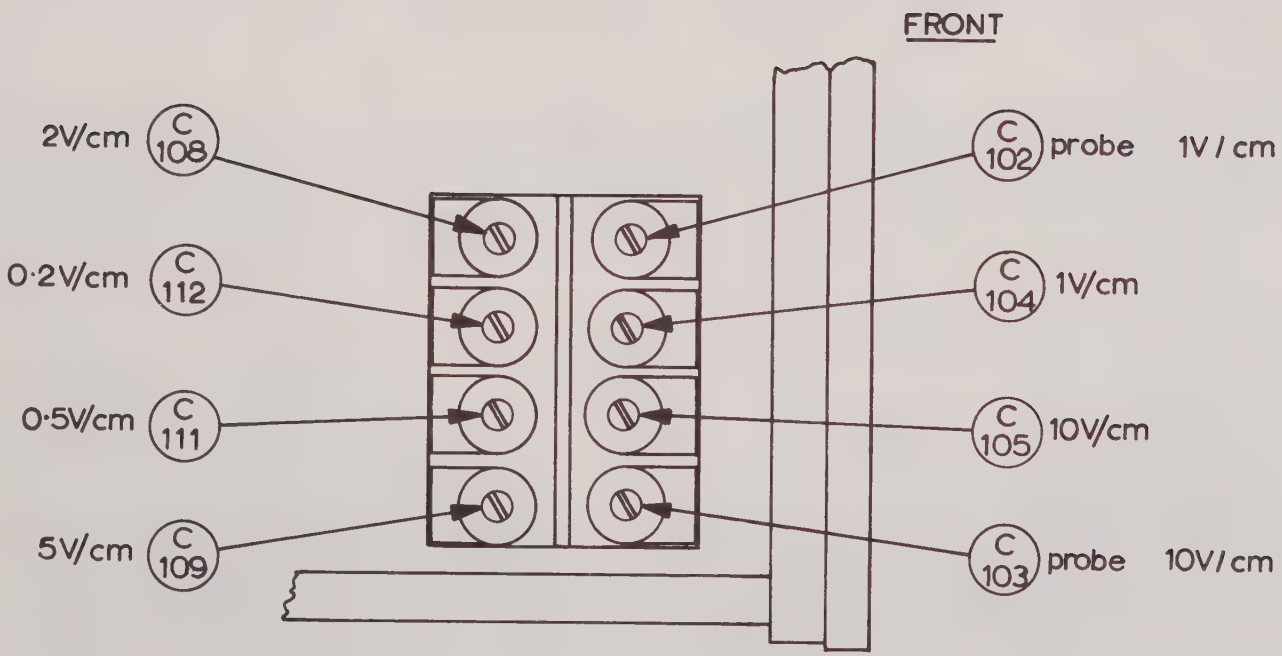
* Omitted from S51E

Cct. ref.	Part number	Value	Description	Tol. %	Rating
C112	281-0137-00	6-30p	CT		350
C113	285-0842-00	15p	PS	1p	500
C115	285-0769-00	0.01	PE	20	400
L1	114-0262-00	140-230μH	Variable inductor		
L2	108-0482-00	160μH	Inductor		
L3	108-0482-00	160μH	Inductor		
L4	108-0483-00	16μH	Inductor		
F1	159-0081-00	1A	1¼ in delay 90-130V		
	159-0079-00	0.5A	1¼ in delay 200-240V		
LP1	150-0074-00	6.5V	Lamp L.E.S.		0.15A
MR1	152-0341-00	450V	Rectifier Si		0.5A
MR2	152-0341-00	450V	Rectifier Si		0.5A
MR3	152-0352-00	800V	Rectifier Si		0.2A
MR4	152-0352-00	800V	Rectifier Si		0.2A
MR5	152-0352-00	800V	Rectifier Si		0.2A
MR6	152-0350-00	5.6kV	Rectifier Se		0.48mA
MR7	152-0062-01		1N914 Si		
MR8	152-0062-01		1N914 Si		
MR9	152-0062-01		1N914 Si		
N1	150-0069-00	60V	Neon 3L		
N2	150-0069-00	60V	Neon 3L		
S1	311-0822-00		Rotary (with RV27)		
* S2	260-0926-00		Slide		
S3	260-0926-00		Slide		
* S4	260-0926-00		Slide		
S5	311-0769-00		Rotary (with RV38)		
S6	260-0970-00		Push (on RV71)		
S7	311-0762-00		Rotary (with RV71)		
S8	260-0947-00		Rotary		
S101	260-0926-00		Slide		
S102	260-0934-00		Rotary		
T1	120-0533-00		Transformer		
TR1	151-0242-00		SPS 2506 Motorola Si		
V1	154-0187-01		ECC88/6DJ8		
V2	154-0187-01		ECC88/6DJ8		
V3	154-0187-01		ECC88/6DJ8		
V4	154-0187-01		ECC88/6DJ8		
V5	154-0187-01		ECC88/6DJ8		
V6	154-0278-01		ECF80/6BL8		
V7	154-0187-01		ECC88/6DJ8		
CRT	154-0523-00		SE5F P31 phosphor		
	154-0545-00		P7 "		
	154-0548-00		P11 "		

* Omitted from S51E

MECHANICAL PARTS

Part number	Qty.	Description
388-1074-00	1	Board, etched circuit PC56, unwired
670-0601-00	1	" " " " wired, but less valves
161-0050-00	1	Cable, power plastic, red-black-green (standard)
161-0054-00	1	" " rubber, " " "
161-0051-00	1	" " plastic, white-black-green (with 3-pin plug)
437-0098-00	1	Case, cabinet cover
343-0212-00	2	Clamp, handle holding
344-0183-00	7	Clip, valve retaining
131-0655-00	1	Connector, insulated PDA wired
200-0911-00	1	Cover, graticule
348-0169-00	2	Foot, front
348-0168-00	2	" rear
426-0449-00	1	Frame, front cast
331-0220-00	1	Graticule, green for P31 (standard)
331-0236-00	1	" amber for P7
331-0249-00	1	" blue for P11
367-0101-00	1	Handle, plastic covered
352-0153-00	1	Holder, fuse
366-1074-00	6	Knob, black: Brightness, Focus, X gain & shift, Stability, Trig level
366-1070-01	2	Knob, black: Volts/cm, Time/cm
366-1072-00	2	Knob, red: Y shift, Variable time/cm
334-1295-00	1	Nameplate S51B
334-1342-00	1	" S51E
220-0512-00	4	Nut, knurled graticule cover
333-1108-00	1	Panel, control, front upper
333-1109-00	1	" " " lower S51B
333-1185-00	1	" " " " S51E
333-1116-00	1	" rear
348-0183-00	4	Shockmount, moulded, CRT front
136-0302-00	1	Socket, CRT B12F
136-0318-00	1	" lamp L.E.S.
136-0289-00	4	" rear 4mm
136-0293-00	7	" valve B9A
131-0654-00	3	Terminal, front
ACCESSORIES	Supplied with instrument or * available to order	
* 103-0085-00	1	Adaptor, input, UHF female to 2-pin
* 016-0251-00	1	Hood, viewing
003-0617-00	1	Key, socket-head screw, 4BA
012-0129-00	1	Leads, input, complete in wallet, comprising:
344-0166-00	2	Clip, crocodile
200-0967-00	1	Cover, rubber, red
200-0968-00	1	" " black
134-0098-00	2	Plug, 4mm
006-1197-00	1	Wallet, PVC
175-0805-00	1 yd	Wire, PVC, 14/.0076, red
175-0806-00	1 yd	" " " black
070-0792-00	1	Manual
* 016-0138-00	1	Protector muff, padded canvas

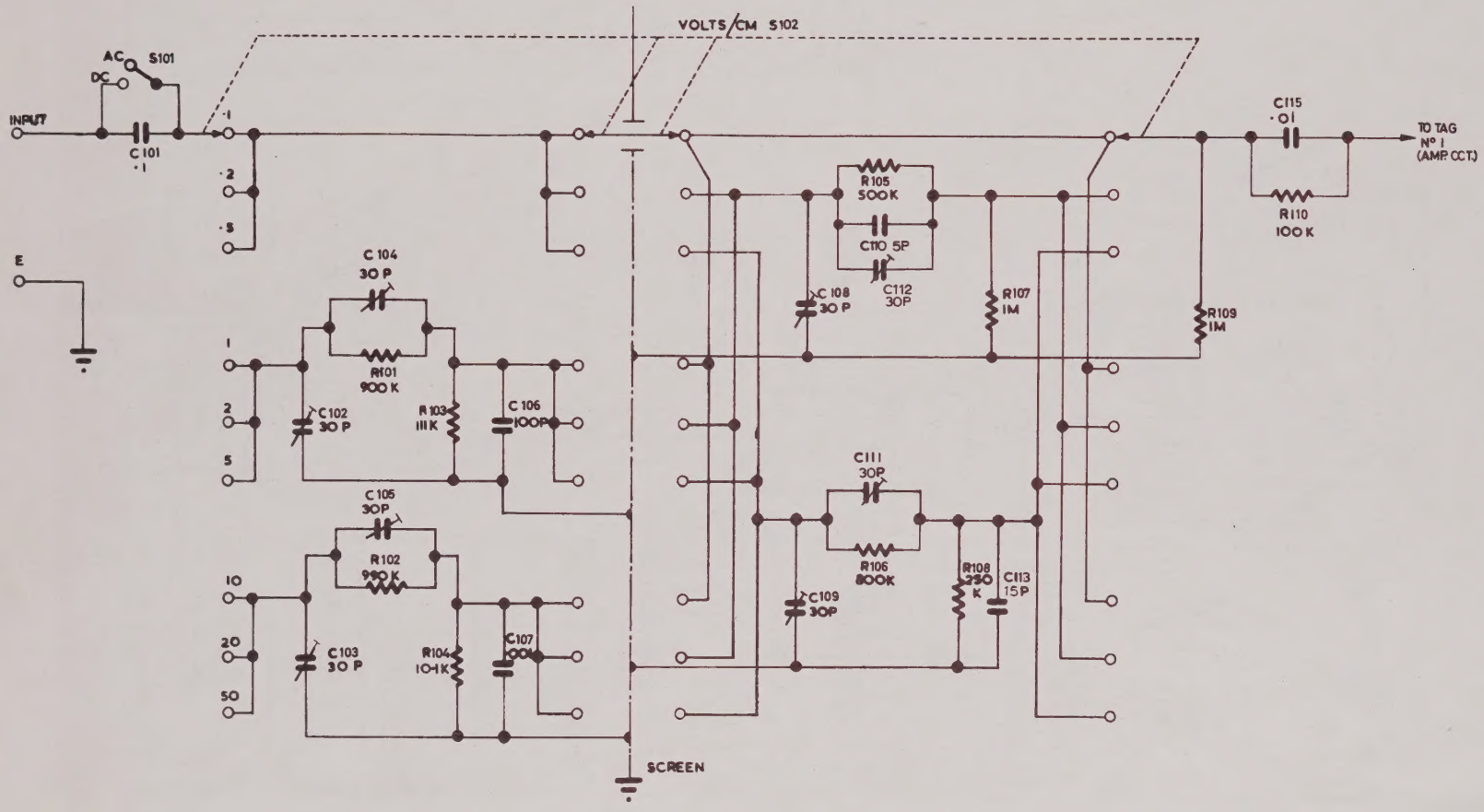


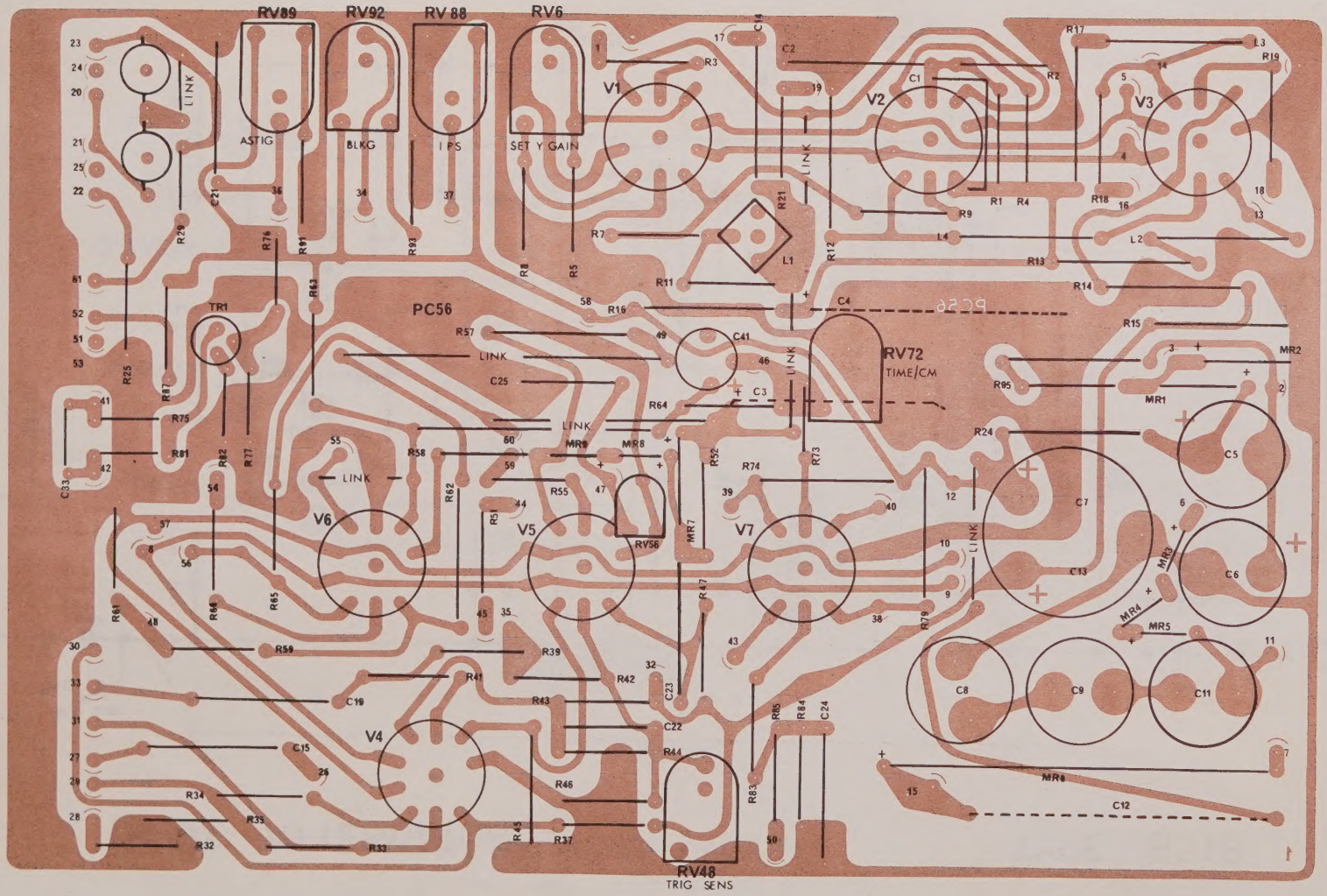
VIEW OF SIDE

INPUT ATTENUATOR PRE-SET
CAPACITOR LOCATIONS

PLATE. 1.

INPUT ATTENUATOR TYPE S51B




RV89
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RV 88
RV6
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BLKG
I PS
SET Y GAIN
PC56
RV72
TIME/CM
RV48
TRIG SENS
V1
V2
V3
V4
V5
V6
V7
TR1
L1
LINK
MR1
MR2
MR3
MR4
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MR8
RV56
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